

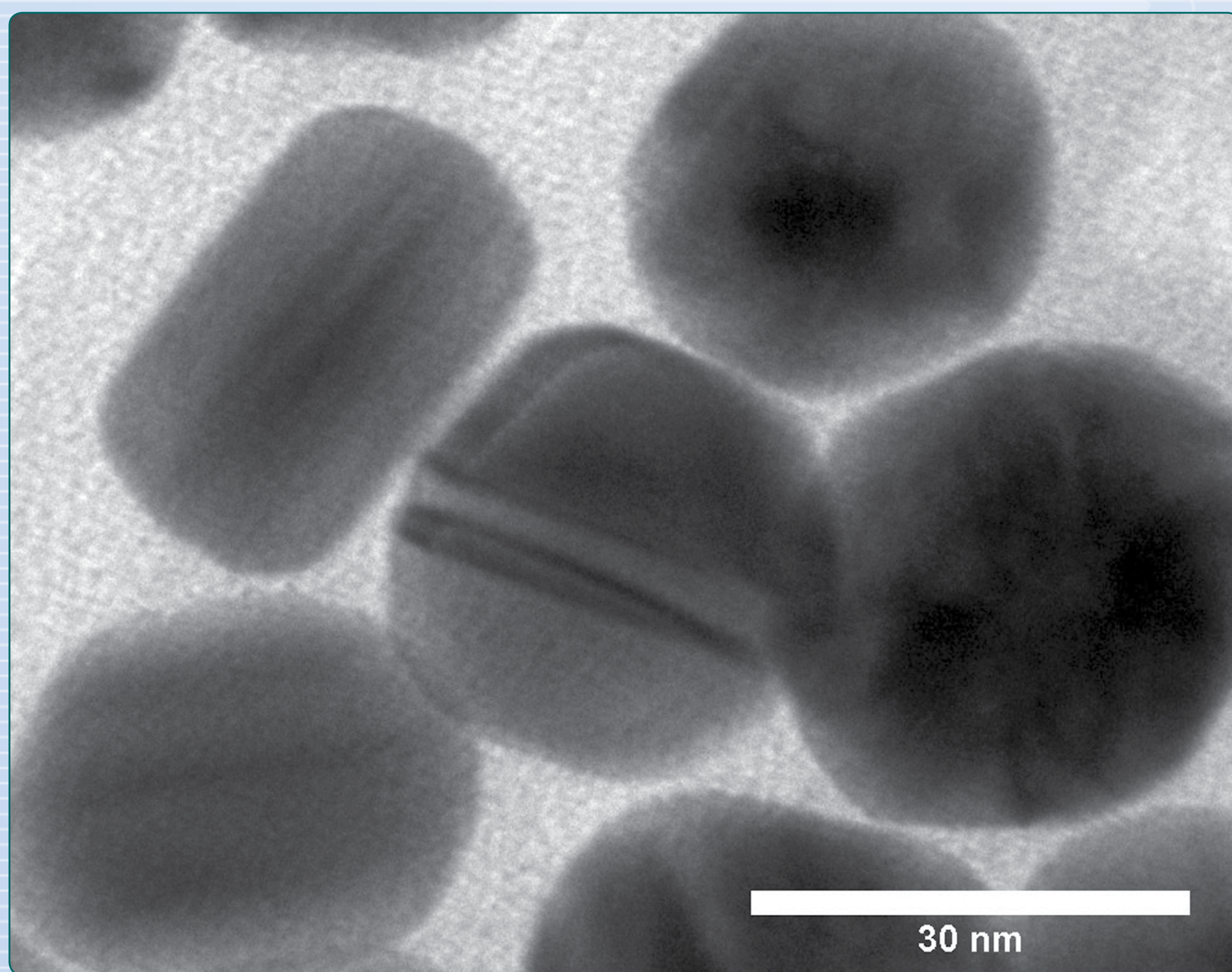
# Traceable characterisation of nanoparticles

## The need for the project

Nanoparticles have many applications, e.g. in suspensions in the ink industry, in drug delivery or as diagnostic agents for the pharmaceutical industry and in novel composite materials to improve properties such as strength and electrical conductivity.

However, at the start of this project, there were no formally recognised, traceable calibration standards and only one European National Metrology Institute could measure the size of spherical nanoparticles.

This project aimed to provide traceable calibration of nanoparticles smaller than 100 nm with better than 1 nm accuracy. It focused on nanoparticle sample preparation, traceable measurement of spherical nanoparticles and high aspect ratio nanoparticles.



TEM image of 30 nm gold nanoparticles. Note that the shape of the particles is not quite spherical.

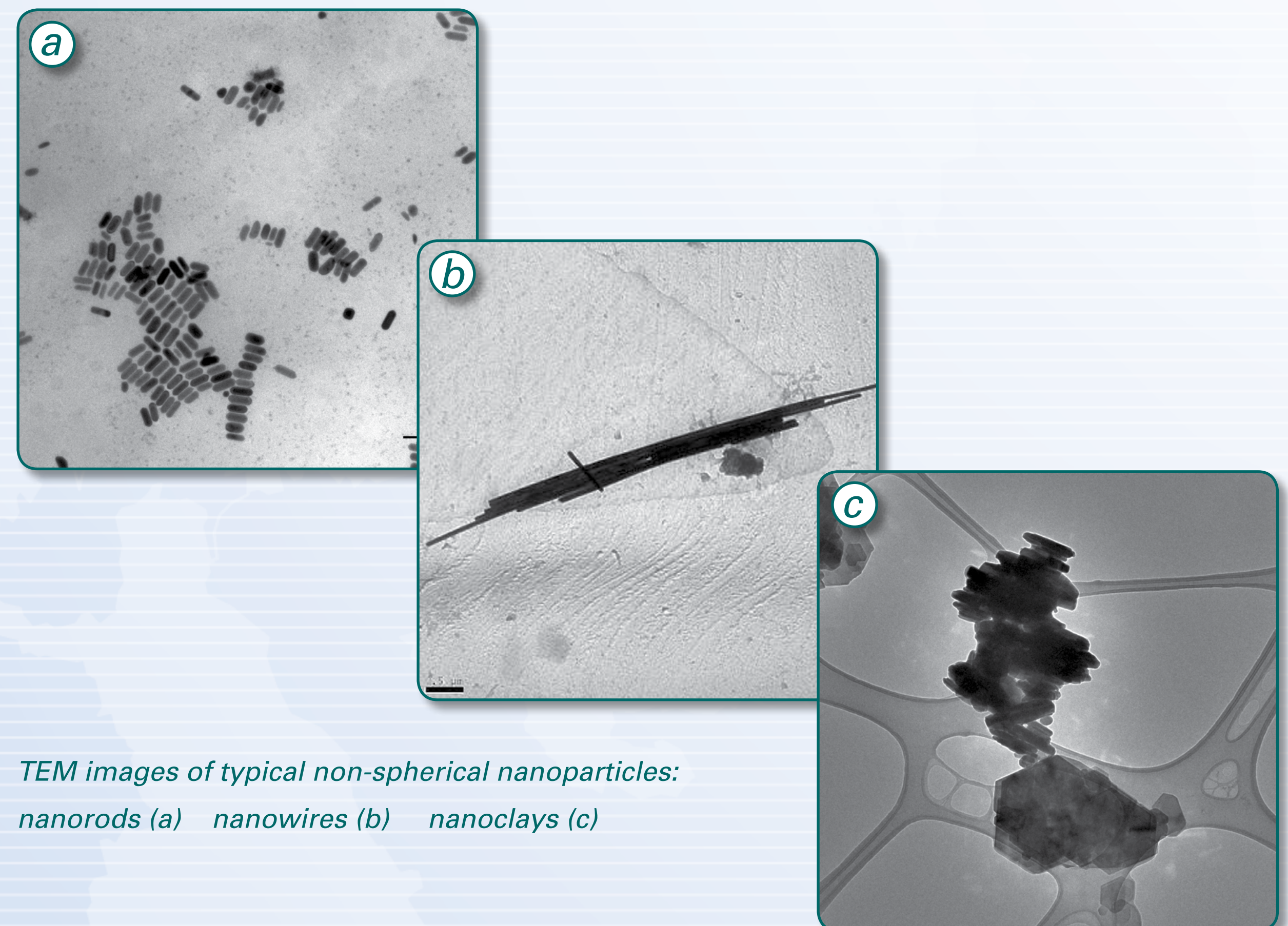
## Technical achievements

This project established dimensional traceability for a range of nanoparticle measurement techniques:

- Scanning Probe Microscopy (SPM)
- Scanning Transmission Electron Microscopy (STEM)
- Transmission Electron Microscopy (TEM)
- Scanning Electron Microscopy (SEM)
- Dynamic Light Scattering (DLS)
- Small Angle X-ray Scattering (SAXS)

The project identified artefacts for these techniques and conducted inter-laboratory comparisons of particle size measurements. The results demonstrated an uncertainty of less than 1 nm.

A new prototype instrument for aerosol particle measurement was also produced and validated: SCAR (Single Charge Aerosol Reference), which produces singly charged particles in a wide particle size range.



TEM images of typical non-spherical nanoparticles: nanorods (a) nanowires (b) nanoclays (c)

## Reference materials

Contributed to the first European Reference materials for Nanoparticles. To achieve this, four of the JRP-Partners participated in a validation exercise for nanoparticle measurement techniques (i.e. DLS, STEM, SPM, SEM, and SAXS).

## Input to standards

The project results have fed into two international standard committees through JRP-Partner (CEM, NPL, INRIM – TC229 and MIKES – TC24) membership:

*ISO TC229 Nanotechnologies*

*ISO TC24 Particle characterisation including sieving*

## Good Practice Guides

Prepared a Good Practice Guide on the accurate measurement of spherical nanoparticles, to enable end-users to set up and carry out measurement of nanoparticles with minimal uncertainty.